

1           4. (Amended) The system as described in claim 2, wherein the vessel  
2 more preferably comprises endothelial cells from a mammal.

3  
4           6. (Amended) The method as described in claim 5, wherein the vessel  
5 more preferably comprises endothelial cells from a mammal.

6  
7           7. (Added) The system as described in claim 1, further comprising  
8 a means for controlling the pumps, and wherein the upstream pump and the  
9 downstream pump are operatively connected with the means for controlling the  
10 pumps.

11  
12           8. (Added) The system as described in claim 1, wherein the upstream  
13 pump and the downstream pump are preferably out of phase with each other.

14  
15           9. (Added) The system as described in claim 1, further comprising  
16 a chamber for receiving the vessel therein, and wherein the chamber further  
17 comprises a means for controlling pressure.

18  
19           10. (Added) The system as described in claim 1, further comprising  
20 a reservoir for retaining the fluid.

21  
22           11. (Added) A system for hemodynamic simulation, the system  
23 comprising:

24                   a fluid;  
25                   a vessel through which the fluid may be urged;  
26                   a chamber in which the vessel is received, the chamber further  
27 including a means for controlling pressure;  
28                   a reservoir for retaining the fluid;  
29                   a plurality of pumps in fluid communication with the fluid; one  
30 of the pumps urging the fluid through the vessel; and  
31                   a means for controlling the pumps, and wherein the pumps are  
32 operatively connected with the means for controlling the pumps.

33  
34           12. (Added) The system as described in claim 11, wherein the means  
35 for controlling the pumps comprises a motor, a cam, and a means for linking the  
36 pumps.

1           13. (Added) The system as described in claim 12, wherein the means  
2 for linking the pumps is adjustable, and wherein the pumps are preferably out of  
3 phase with each other.

4  
5           14. (Added) The system as described in claim 13, wherein the pumps  
6 are more preferably out of phase with each other by between approximately ten and  
7 approximately three hundred sixty degrees.

8  
9           15. (Added) The system as described in claim 14, wherein the pumps  
10 are most preferably out of phase with each other by approximately between ninety  
11 and approximately one-hundred-eighty degrees.

12  
13           16. (Added) The system as described in claim 12, wherein the means  
14 for controlling the pumps is selected from the group consisting of a cam  
15 mechanism; a multi-bar linkage mechanism; a solenoid; a stepper motor; an  
16 electric motor; a linear ball actuator; a belt driven actuator; and a chain  
17 driven actuator.

18  
19           17. (Added) The system as described in claim 11, further comprising  
20 a third pump, the third pump being connected to the chamber, and wherein when the  
21 means for controlling pressure is applied to the chamber, pressure is exerted on  
22 the vessel.

23  
24           18. (Added) The system as described in claim 17, further comprising  
25 a means for adjusting the downstream flow of the fluid between the vessel and the  
26 reservoir.

27  
28           19. (Added) The system as described in claim 18, further comprising  
29 a steady flow pump, the steady flow pump being positioned between the reservoir  
30 and one of the pumps.

31  
32           20. (Added) The system as described in claim 19, further comprising  
33 a means for filtering noise, the means for filtering noise being positioned  
34 between the steady flow pump and the vessel.

35  
36           21. (Added) The system as described in claim 16, wherein the means

1 for controlling the pumps further comprises a computer system.

2  
3 22. (Added) The system as described in claim 11, wherein the vessel  
4 is chosen from the group consisting of mammalian blood vessels; models of  
5 mammalian blood vessels; endothelial cells; osteocytes; chondrocytes; and muscle  
6 cells.

7  
8 23. (Added) The system as described in claim 11, wherein the  
9 plurality of pumps comprises:

10 an upstream pump in fluid communication with the fluid; the  
11 upstream pump urging the fluid through the vessel in a pushing manner; and  
12 a downstream pump in fluid communication with the fluid; the  
13 downstream pump being downstream said upstream pump; the downstream pump urging  
14 the fluid through the vessel in a pulling manner.

15  
16 24. (Added) The system as described in claim 11, wherein the  
17 plurality of pumps comprises:

18 a pair of upstream pumps in fluid communication with the fluid.

19  
20 25. (Added) The system as described in claim 11, wherein the  
21 plurality of pumps comprises:

22 an upstream pump in fluid communication with the fluid; the  
23 upstream pump urging the fluid through the vessel in a pushing manner; and  
24 an external pump, the external pump being operatively connected  
25 to the chamber, wherein when the means for controlling pressure is applied to the  
26 chamber, pressure is exerted on the vessel.

27  
28 26. (Added) The system as described in claim 11, wherein the  
29 plurality of pumps comprises:

30 a downstream pump in fluid communication with the fluid; the  
31 downstream pump, the downstream pump urging the fluid through the vessel; and  
32 an external pump, the external pump being operatively connected  
33 to the chamber, wherein when the means for controlling pressure is applied to the  
34 chamber, pressure is exerted on the vessel.

35  
36 27. (Added) A system for hemodynamic simulation, the system

1 comprising:

2 a fluid;  
3 a vessel through which the fluid may be urged;  
4 a chamber in which the vessel is received, the chamber further  
5 including a means for controlling pressure;  
6 a reservoir for retaining the fluid;  
7 a plurality of pumps in fluid communication with the fluid; one  
8 of the pumps urging the fluid through the vessel; and  
9 a means for controlling the pumps, comprising a motor, a cam, and a  
10 means for linking the pumps with each other, the pumps being operatively  
11 connected with the means for controlling the pumps, the means for linking the  
12 pumps being adjustable, the pumps preferably being out of phase with each other.

13  
14 28. (Added) The system as described in claim 27, wherein the  
15 plurality of pumps comprise:

16 an upstream pump in fluid communication with the fluid; the  
17 upstream pump urging the fluid through the vessel in a pushing manner; and  
18 a downstream pump in fluid communication with the fluid, the  
19 downstream pump being downstream of the upstream pump, the downstream pump urging  
20 the fluid through the vessel in a pulling manner;  
21 and the system further comprising a third pump, the third pump operatively  
22 connected to the means for controlling the pumps, the third pump being connected  
23 to the chamber, and wherein when the means for controlling pressure is applied  
24 to the chamber, pressure is exerted on the vessel.

25  
26 29. (Added) The system as described in claim 28, wherein the vessel  
27 is chosen from the group consisting of mammalian blood vessels; models of  
28 mammalian blood vessels; endothelial cells; osteocytes; chondrocytes; and muscle  
29 cells.

30  
31 30. (Added) The system as described in claim 27, wherein the  
32 plurality of pumps comprise:

33 a pair of upstream pumps in fluid communication with the fluid.

34  
35 31. (Added) The system as described in claim 27, wherein the  
36 plurality of pumps comprise:

1           an upstream pump in fluid communication with the fluid; the  
2 upstream pump urging the fluid through the vessel in a pushing manner; and  
3           an external pump, the external pump being operatively connected  
4 to the chamber, wherein when the means for controlling pressure is applied to the  
5 chamber, pressure is exerted on the vessel.  
6

7           32. (Added) The system as described in claim 27, wherein the  
8 plurality of pumps comprise:

9           a downstream pump in fluid communication with the fluid; the  
10 downstream pump urging the fluid through the vessel in a pulling manner; and  
11           an external pump, the external pump being operatively connected  
12 to the chamber, wherein when the means for controlling pressure is applied to the  
13 chamber, pressure is exerted on the vessel.  
14

15           33. (Added) A method for simulating biomechanical stimuli, the  
16 method comprising the steps of:

17           providing a fluid;  
18           providing a vessel through which the fluid may be urged;  
19           providing a chamber for receiving the vessel therein, the  
20 chamber further including a means for controlling pressure;  
21           providing an upstream pump in fluid communication with the  
22 fluid, the upstream pump urging the fluid through the vessel in a pushing manner;  
23 and

24           providing a downstream pump in fluid communication with the  
25 fluid, the downstream pump urging the fluid through the vessel in a pulling  
26 manner.  
27

28           34. (Added) The method as described in claim 33, further comprising  
29 the step of providing a third pump, the third pump being connected to the  
30 chamber.  
31

32           35. (Added) The method as described in claim 34, further comprising  
33 the step of applying the means for controlling pressure to the chamber, thereby  
34 exerting pressure on the vessel.  
35

36           36. (Added) The method as described in claim 33, wherein the vessel

1 is chosen from the group consisting of mammalian blood vessels; models of  
2 mammalian blood vessels; endothelial cells; osteocytes; chondrocytes; and muscle  
3 cells.  
4

5 37. (Added) The method as described in claim 35, further comprising  
6 the step of providing a means for controlling the pumps, wherein the upstream  
7 pump and the downstream pump are operatively connected with the means for  
8 controlling the pumps.  
9

10 38. (Added) The method as described in claim 37, wherein the means  
11 for controlling the pumps comprises a motor, a cam, and a means for linking the  
12 upstream pump with the downstream pump.  
13

14 39. (Added) The method as described in claim 38, wherein the means  
15 for linking the upstream pump and the downstream pump is adjustable, and wherein  
16 the upstream pump and the downstream pump are preferably out of phase with each  
17 other.  
18

19 40. (Added) The method as described in claim 39, wherein the  
20 upstream pump and the downstream pump are more preferably out of phase with each  
21 other by between approximately ten and approximately three hundred sixty degrees.  
22

23 41. (Added) The method as described in claim 40, wherein the  
24 upstream pump and the downstream pump are most preferably out of phase with each  
25 other by approximately between ninety and approximately one-hundred-eighty  
26 degrees.  
27

28 42. (Added) The method as described in claim 41, wherein the means  
29 for controlling the pumps is selected from the group consisting of a cam  
30 mechanism; a multi-bar linkage mechanism; a solenoid; a stepper motor; an  
31 electric motor; a linear ball actuator; a belt driven actuator; and a chain  
32 driven actuator.  
33

34 43. (Added) The method as described in claim 42, further comprising  
35 the step of providing a reservoir for retaining the fluid, the reservoir being  
36 in fluid communication with the vessel.

1           44. (Added) The method as described in claim 43, further comprising  
2 the step of providing a means for adjusting the downstream flow of the fluid  
3 between the vessel and the reservoir.  
4

5           45. (Added) The method as described in claim 44, further comprising  
6 the step of providing a steady flow pump, the steady flow pump being positioned  
7 between the reservoir and the upstream pump.  
8

9           46. (Added) The method as described in claim 45, further comprising  
10 the step of providing a means for filtering noise, the means for filtering noise  
11 being positioned between the steady flow pump and the vessel.  
12

13           47. (Added) The method as described in claim 46, wherein the means  
14 for controlling the pumps further comprises a computer system.  
15

16           48. (Added) The method as described in claim 33, wherein the  
17 biomechanical stimuli are chosen from the group consisting of wall shear stress,  
18 circumferential strain, pulsatile pressure, transmural pressure, and biologically  
19 active agents.  
20

21           49. (Added) A method for hemodynamic simulation, the method  
22 comprising the steps of:

23           providing a fluid;  
24           providing a vessel through which the fluid may be urged;  
25           providing a chamber in which the vessel is received, the  
26 chamber further including a means for controlling pressure;  
27           providing a reservoir for retaining the fluid;  
28           providing a plurality of pumps in fluid communication with the  
29 fluid, wherein one said pumps urges the fluid through the vessel; and  
30           providing a means for controlling the pumps, comprising a  
31 motor, a cam, and a means for linking the pumps with each other, the pumps being  
32 operatively connected with the means for controlling the pumps, the means for  
33 linking the pumps being adjustable, the pumps preferably being out of phase with  
34 each other.  
35

36           50. (Added) The system as described in claim 49, wherein the vessel

1 is chosen from the group consisting of mammalian blood vessels; models of  
2 mammalian blood vessels; endothelial cells; osteocytes; chondrocytes; and muscle  
3 cells.  
4

5 51. (Added) The method as described in claim 49, further comprising:  
6 providing an upstream pump in fluid communication with the  
7 fluid; the upstream pump urging the fluid through the vessel in a pushing manner;  
8 and

9 providing a downstream pump in fluid communication with the  
10 fluid, the downstream pump being downstream of the upstream pump, the downstream  
11 pump urging the fluid through the vessel in a pulling manner; and

12 providing a third pump, the third pump operatively connected  
13 to the means for controlling the pumps, the third pump being connected to the  
14 chamber, and wherein when the means for controlling pressure is applied to the  
15 chamber, pressure is exerted on the vessel.  
16

17 52. (Added) The method as described in claim 49, further comprising:  
18 providing a pair of upstream pumps in fluid communication with  
19 the fluid.  
20

21 53. (Added) The method as described in claim 49, further comprising:  
22 providing an upstream pump in fluid communication with the  
23 fluid; the upstream pump urging the fluid through the vessel in a pushing manner;  
24 and

25 providing an external pump, the external pump being operatively  
26 connected to the chamber, wherein when the means for controlling pressure is  
27 applied to the chamber, pressure is exerted on the vessel.  
28

29 54. (Added) The method as described in claim 49, further comprising:  
30 providing a downstream pump in fluid communication with the  
31 fluid; the downstream pump urging the fluid through the vessel in a pulling  
32 manner; and

33 providing an external pump, the external pump being operatively  
34 connected to the chamber, wherein when the means for controlling pressure is  
35 applied to the chamber, pressure is exerted on the vessel.  
36